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Subscription Information
An annual subscription to Fuel Cells Bulletin includes 12 issues and online access for up to 5 users.
Prices:
€1334 for all European countries & Iran
US$1495 for all countries except Europe and Japan
¥177 200 for Japan
(Prices valid until 31 December 2013)
To subscribe send payment to the address above.
Tel: +44 (0)1865 843687
or via www.fuelcellsbulletin.com

Subscriptions run for 12 months, from the date payment is received.

12977
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Mayfield Press (Oxford) LImited

ROAD VEHICLES

First Hyundai ix35 FCEV rolls off assembly line in Korea

The first Hyundai ix35 Fuel Cell car has rolled off the dedicated assembly line at the company's Ulsan manufacturing complex in Korea. The inaugural vehicle sees Hyundai become the world's first automaker to begin assembly-line mass production of hydrogen fuel cell electric vehicles (FCEVs) for fleet use.

The ix35 Fuel Cell vehicle, based on Hyundai's popular ix35, C-segment SUV (known as the Tucson in some markets), exited the assembly line at Hyundai Motor's Plant No. 5 during a launch event attended by Hyundai top management and VIPs. Hyundai anticipates beginning production of hydrogen FCEVs for consumer retail sales after 2015, with lowered vehicle production costs and further developed hydrogen infrastructure.

The ix35 Fuel Cell unveiled at the ceremony is one of 17 destined for fleet customers in the Danish capital Copenhagen and in Skåne province in Sweden – which are joined by the spectacular Øresund Bridge. The Municipality of Copenhagen, as part of its initiative to be carbon-free by 2025, will be supplied with 15 ix35 Fuel Cell cars for fleet use, according to an agreement announced last September [*FCB*, September 2012, p1]. Two vehicles will be supplied to Skåne Regional Council [*FCB*, November 2012, p2].

Hyundai plans to build 1000 ix35 Fuel Cell vehicles by 2015 for lease to public and private fleets, primarily in Europe, where the European Union has established a hydrogen roadmap and initiated construction of hydrogen fuelling stations [*FCB*, December 2012, p8]. Furthermore, the Danish government's Energy Plan 2020 is establishing a range of initiatives for a nationwide hydrogen infrastructure and FCEVs [*see the News Feature in FCB, April 2012, p12*], building on the Scandinavian aim of a regional hydrogen refuelling network by 2015, coordinated by the Scandinavian Hydrogen Highway Partnership [*see the SHHP feature in FCB, March 2011*].

Hyundai, Zero-Emission Vehicles:
http://tinyurl.com/hyundai-zevs

Scandinavian Hydrogen Highway Partnership:
www.scandinavianhydrogen.org

Next stages under way for fuel cell buses in Aberdeen, Flanders

Hydrogen fuel cell bus projects in the Scottish city of Aberdeen and in the Flanders region of Belgium have taken their next steps towards demonstrating the hybrid buses in public service.

On 11 February, the Aberdeen fuel cell bus project, co-funded by the European Fuel Cells and Hydrogen Joint Undertaking (FCH JU), got under way. A total of nine buses will operate in urban and suburban service in the coming year as part of the Aberdeen Hydrogen Project. Last August Scottish First Minister Alex Salmond gave the green light for a pioneering clean energy hub in Scotland, as he announced funding of up to £3.3 million (US$4.9 million) for the EU-backed project [*FCB*, September 2012, p10], with additional funding from the UK government-supported Technology Strategy Board.

The first phase of the Aberdeen Hydrogen Project has a budget of £20 million ($30 million), and will by early 2014 deliver an initial 'green' hydrogen infrastructure in Aberdeen. This will include hydrogen production from a 1 MW electrolyser powered by a wind turbine, a means of transporting the hydrogen to the refuelling station, a state-of-the-art hydrogen station, and a fleet of 10 hydrogen buses to be operated by FirstGroup and Stagecoach.

The Scottish government and Scottish Enterprise funding will enable Aberdeen City Council, supported by Aberdeen Renewable Energy Group, to start the project's first phase with an order for nine Van Hool fuel cell buses. BOC is coordinating the project, and will take care of developing a green hydrogen supply chain linked to abundant Scottish wind resources. The other industrial partners are utility SSE (formerly Scottish and Southern Energy) and Scotland Gas Networks.

The Hydrogen Fuel Cells and Electro-mobility in European Regions association (HyER), together with Aberdeen Renewable Energy Group and energy consultancy Element Energy, will ensure that the project results will be disseminated at local, national, and EU level. They will leverage links with ongoing FCH JU bus projects, such as the Clean Hydrogen in European Cities (CHIC) and High V.LO-City projects [*see the CHIC feature in FCB, November 2010*].

Meanwhile in Belgium, the Flemish regional government has approved the decision to buy 386 buses to replace the oldest and most

polluting vehicles with more cost-effective and environmentally friendly ones. This major fleet overhaul will include five hydrogen fuel cell buses – built by the Flemish bus manufacturer Van Hool – integrated into the fleet of transport operator De Lijn.

The buses are part of the EU's five-year, €31.6 million ($41 million) High V.LO-City project, which aims to accelerate the deployment of the latest-generation hydrogen fuel cell buses in public transport operations in Flanders, Liguria in Italy, and Scotland. The five vehicles – to be delivered by the end of the year – will be operated in the northern province of Antwerp, so they can be refuelled at Solvay's hydrogen station, which uses industrial by-product hydrogen.

Aberdeen City Council, Aberdeen Hydrogen Project: http://tinyurl.com/aberdeen-h2

Hydrogen Fuel Cells and Electro-mobility in European Regions (HyER): www.hyer.eu

European Fuel Cells and Hydrogen Joint Undertaking: www.fch-ju.eu

High V.LO-City project: www.highvlocity.eu

Van Hool, hybrid fuel cell buses: http://tinyurl.com/vanhool-h2

MOBILE APPLICATIONS

Toyota Industries trialling next-gen fuel cell forklifts in demo

Toyota Industries Corporation in Japan has unveiled its next-generation fuel cell powered forklift, two units of which are being demonstrated in the Kitakyushu Smart Community Creation Project in the city of Kitakyushu in southern Japan, with support from the Ministry of Economy, Trade and Industry (METI).

The 2.5 tonne forklift – powered by a hydrogen PEM fuel cell rated at 8 kW continuous power, 32 kW maximum output – was developed jointly by Toyota Industries (known in Japan as Toyota Shokki) and automaker Toyota Motor Corporation. The two vehicles began operation in December at a plant owned by another Toyota company, plastic components manufacturer Toyoda Gosei Co Ltd. The demonstration project will run through March 2014.

The materials handling vehicles can be refuelled with 1.2 kg of hydrogen in about 3 minutes at the facility's 350 bar (5000 psi) hydrogen station, which utilises by-product hydrogen generated at the Nippon Steel & Sumitomo Metal Corporation's nearby Yawata steelworks. Using hydrogen fuel cells allows almost continuous operation without battery replacement and charging, for substantially improved operational efficiency in comparison with battery electric forklifts [*see the forklifts feature in FCB, September 2010*].

Toyota Industries first announced a prototype in autumn 2005 [*FCB*, December 2005, p3], and has been continuing R&D with the aim of commercialising fuel cell powered forklifts from 2015.

Toyota Industries Corporation: www.toyota-industries.com

Toyota Motor Corporation: www.toyota-global.com

Toyoda Gosei Co Ltd: www.toyoda-gosei.com

SMALL STATIONARY

AFC Energy ships first unit to ICL chlor-alkali plant, office in Korea

In the UK, AFC Energy has delivered the first fuel cell electricity generating system to Industrial Chemicals Ltd. The shipment is in advance of a 1 MW project to install the world's largest alkaline fuel cell system at ICL's chlor-alkali plant. AFC has also opened an office in South Korea, to focus on regional market development and sales.

The AFC Energy shipment is in preparation for the 1 MW project announced last summer, to install the commercial-scale alkaline fuel cell energy generation system at ICL's new chlor-alkali plant in Essex [*FCB*, June 2012, p1]. The project is supported with a €6.1 million (US$7.9 million) grant through the European Fuel Cells and Hydrogen Joint Undertaking [*FCB*, December 2012, p5].

The first delivery was of a skid-mounted (mobile) Beta system, which should be installed and commence supplying small amounts of power to the chemicals works from April. It will generate clean energy using by-product hydrogen from the chemicals works. This system will test and qualify the hydrogen supply and site infrastructure ahead of the staged larger system installation later this year.

As part of the project, AFC Energy is to provide electric power to ICL under its first ESCO (energy supply company) arrangement, whereby ICL will provide hydrogen and purchase power under long-term contracts. AFC Energy will own, operate, and maintain the fuel cell systems [*see the AFC Energy feature in FCB, November 2011*].

EDITORIAL

Green hydrogen is widely seen as a key aspect of the wider application of fuel cells, with a wide variety of ways of producing it renewably – either using electricity generated from renewable energy sources, or extracting it from biomass or waste product.

We report on all of these approaches in this issue. The front page item on BMW's US manufacturing facility refers to the plant's landfill gas-to-hydrogen pilot project, which later this year will see side-by-side trials of materials handling equipment fuelled by 'green' hydrogen derived from landfill gas versus commercially sourced hydrogen.

A Ballard ClearGen™ distributed generation fuel cell system is being installed on the Blue Lake Rancheria Tribe reservation in northern California [*see page 4*]. The power plant will use pyrolysis gasification to convert locally grown timber by-product feedstock into hydrogen-rich syngas, which will be purified and used to power the fuel cell. Meanwhile, FuelCell Energy will demonstrate a trigeneration stationary Direct FuelCell® molten carbonate fuel cell power plant in British Columbia that will operate on landfill gas [*also page 4*]. The system will supply hot water to greenhouses, while co-produced hydrogen will be exported for vehicle fuelling or industrial applications. And don't forget the AFC Energy alkaline fuel cell pilot system running on by-product hydrogen at the Industrial Chemicals Ltd chlor-alkali plant in the UK, in preparation for the 1 MW installation later this year [*this page*].

On the fuelling side, the HyNor Lillestrøm project is demonstrating hydrogen production and compression technology developed in Norway [*see page 6*]. A sorption-enhanced steam methane reformer developed by the IFE Institute for Energy Technology will convert landfill gas (upgraded to biogas quality) to hydrogen for refuelling vehicles.

In South Africa, the HySA Infrastructure Center of Competence has received a state-of-the-art Heliocentris solar-to-hydrogen installation, joining a Proton OnSite PEM electrolyser that will be integrated into a 6 kW solar-to-hydrogen pilot plant [*see page 6*]. And Acta is working with the EcoIsland Partnership in the UK, to provide a domestic renewable energy storage solution that produces and stores hydrogen for use in a Dantherm Power fuel cell in a house in the Isle of Wight [*see page 7*]. The system is powered by renewable off-grid power, and when installed will generate hydrogen directly from the solar PV panels on the house.

The feature article in this issue comes from one of Elsevier's material science journals. The paper, on direct foamed and nanocatalyst impregnated solid oxide fuel cell cathodes, caught my eye as an interesting development for improved SOFC performance.

Steve Barrett